STEM AERO

AI, ROBOTICS & STEM

10-Year Progressive Curriculum

Classes 3 to 12

A practical, project-based learning pathway from STEM exploration
to AI engineering, machine learning and autonomous robotics.

Curriculum at a Glance

The program increases in complexity across four stages: discovery (3-5), foundations (6-8), advanced application (9-10), and pre-professional AI/robotics engineering (11-12).

Stage	Classes	Primary Focus	Coding	Core Hardware
01	3-5	STEM, basic robotics, sensors and visual coding	Scratch / mBlock	STEM kits, motors, LEDs, basic sensors
02	6-8	Arduino, electronics, IoT and AI foundations	Arduino / mBlock / Python intro	Arduino, ESP32, sensors, motors, camera
03	9-10	Python, ML, computer vision and intelligent robotics	Python / Arduino / Colab	ESP32, Raspberry Pi or PC, camera
04	11-12	AI engineering, deep learning, autonomy and research	Python / ML frameworks / robotics	Edge device, mobile robot, robotic arm

Class Directory

Class	Level	Curriculum Focus	Signature Outcome
Class 3	Beginner	STEM exploration + logic	Balloon car
Class 4	Beginner+	Basic robotics + electronics	Motor car
Class 5	Beginner / Intermediate	Coding + sensors + automation	Automatic fan
Class 6	Intermediate	Arduino + electronics + AI	Digital control panel
Class 7	Intermediate	Robotics + communication + IoT	Bluetooth robot
Class 8	Intermediate / Advanced	Autonomy + vision + ML	Line follower
Class 9	Advanced	Python + ML + autonomous robotics	AI model
Class 10	Advanced	AI + ML + vision + NLP	Prediction model
Class 11	Advanced / Senior Secondary	AI engineering + advanced robotics	Robotic arm
Class 12	Advanced / Pre-Professional	Deep learning + autonomous robotics	AI vision system

Teaching & Assessment Framework

Learning Cycle	What Students Do
Concept	Introduce a clear age-appropriate STEM/AI/robotics concept.
Demonstrate	Teacher demonstration of the component, mechanism or code.
Build	Students assemble or prototype the system.
Code	Students program, test and debug the system where applicable.
Challenge	Students modify the design or solve a new problem.
Reflect	Students document observations, errors, improvements and applications.

Recommended Practical Ratio

Concept / Theory	Hands-on Practical	Project / Challenge
30%	50%	20%

Assessment Lens

Use a balanced assessment model: 25% conceptual understanding, 25% practical execution, 20% coding/problem solving, 20% project quality, and 10% documentation/presentation. This can be adjusted by school grade and project type.

CLASS 3

BEGINNER

CURRICULUM FOCUS

STEM exploration, curiosity, simple machines, circuits and logic

CODING
Scratch / visual coding

HARDWARE
STEM construction materials, LEDs, batteries, simple sensors

AI THREAD
AI awareness through age-appropriate examples

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**STEM Around Us**	Recognize STEM in everyday life.	STEM meaning; science, technology, engineering, mathematics; everyday examples.	STEM scavenger hunt; classify objects as STEM.	Building blocks; household objects	No-code	STEM Discovery Board
2	**What Is a Robot?**	Identify robots and basic robot functions.	Robot definition; human vs machine; robot applications.	Identify robot parts from models and images.	Robot model; picture cards	No-code	Design Your Own Robot
3	**Simple Machines**	Understand how machines make work easier.	Lever; wheel and axle; pulley; inclined plane.	Build and test simple mechanisms.	Cardboard; sticks; wheels; pulleys	No-code	Mini Machine
4	**Force and Motion**	Explore push, pull, friction and movement.	Force; friction; speed; direction.	Test toy cars on different surfaces and ramps.	Toy cars; ramps; surfaces	No-code	Balloon-Powered Car
5	**Wheels and Mechanisms**	Understand rotational movement.	Wheel; axle; gears; mechanical transfer.	Build a moving mechanism.	Wheels; gears; axles	STEM kit	Moving Vehicle
6	**Introduction to Circuits**	Understand a basic electrical circuit.	Battery; wire; load; open and closed circuit.	Make and test a simple LED circuit.	Battery; wires; LED; switch	No-code	LED Lamp
7	**Sensors Around Us**	Understand how machines detect conditions.	Light; sound; touch; temperature sensing.	Explore sensor examples and classify inputs.	LDR; touch switch; thermometer	No-code	Smart Sensor Model
8	**Introduction to Coding**	Develop sequencing and logic.	Algorithm; instruction; sequence.	Create a simple animation or game.	Computer/tablet	Scratch	Animated Story
9	**Conditions and Decisions**	Use if/then thinking.	Condition; decision; if/then.	Create a decision-based interactive program.	Computer	Scratch	Smart Character
10	**Loops and Patterns**	Understand repeated actions.	Loops; patterns; repetition.	Build repeated motion or animation.	Computer	Scratch	Dancing Robot
11	**AI Around Us**	Recognize common AI applications.	AI concept; voice assistants; recommendations; recognition.	Explore safe, teacher-guided AI examples.	Computer/tablet	Web AI demos	AI Around Me Poster
12	**Young Inventor Challenge**	Apply STEM ideas to a real problem.	Design process; prototype; test; improve.	Build, test and improve a prototype.	Mixed STEM materials	Mixed	My First STEM Invention

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 4

BEGINNER+

CURRICULUM FOCUS

basic robotics, electronics, sensors and structured block coding

CODING
Scratch / mBlock

HARDWARE
DC motors, LEDs, buzzers, LDR, ultrasonic sensor, switches

AI THREAD
AI awareness and simple recognition activities

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Robotics in Daily Life**	Understand practical robotics.	Industrial; domestic; educational robots.	Identify real-world robot applications.	Robot examples; images	No-code	Robotics Application Chart
2	**Parts of a Robot**	Identify key robot subsystems.	Controller; sensor; actuator; power.	Assemble a basic robot structure.	Robot chassis; motors	Kit	Robot Body
3	**Motors and Movement**	Understand motor-based motion.	DC motor; rotation; direction.	Run and reverse a motor.	DC motor; battery pack	Kit	Mini Motor Car
4	**Electronics Basics**	Understand basic electrical components.	Voltage; current; polarity; resistance.	Build an LED circuit.	LED; resistor; battery	Tinkercad	LED Circuit
5	**Buzzer and Indicators**	Use sound and light as outputs.	Buzzer; LED; output devices.	Create sound and light signals.	Buzzer; LEDs	Tinkercad	Alarm System
6	**Light Sensors**	Detect light conditions.	LDR; analog input.	Control an LED using light level.	LDR; LED	mBlock	Automatic Night Lamp
7	**Touch and Distance**	Detect contact and objects.	Touch switch; ultrasonic sensing concept.	Measure distance and trigger output.	Ultrasonic sensor; switch	mBlock	Distance Detector
8	**Block Programming**	Build structured programs.	Events; variables; blocks.	Create an interactive program.	Computer	Scratch / mBlock	Interactive Game
9	**Conditions**	Make sensor-based decisions.	If/else logic.	Program a response to a sensor.	Sensor kit	mBlock	Smart Lamp
10	**Loops**	Automate repeated actions.	Repeat; forever; timing.	Create a repeated LED or motor sequence.	Motor; LED	mBlock	Traffic Signal
11	**AI Basics**	Understand simple AI applications.	Learning from examples; recognition.	Try a teacher-guided image/voice demo.	Computer	Web AI tools	AI Recognition Activity
12	**Build a Smart Robot**	Combine robotics concepts.	Integration; testing; troubleshooting.	Assemble and program a small robot.	Robot kit	mBlock	Smart Obstacle Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 5

BEGINNER / INTERMEDIATE

CURRICULUM FOCUS

coding, sensors, automation, environmental technology and ML awareness

CODING
mBlock / Arduino basics

HARDWARE
Arduino-compatible board, DC motors, RGB LED, ultrasonic, temperature, moisture sensor

AI THREAD
data, classification and introductory machine learning

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Engineering Design**	Use a structured problem-solving workflow.	Define; design; prototype; test; improve.	Complete a bridge or load-bearing challenge.	Craft/STEM materials	No-code	Bridge Challenge
2	**DC Motors**	Control speed and direction of motors.	Polarity; rotation; motor control.	Build forward/reverse motor control.	DC motors; driver	Arduino / mBlock	Motor Vehicle
3	**RGB LED**	Understand digital color mixing.	Red, green, blue channels; combinations.	Create multiple LED colors.	RGB LED	Tinkercad	Smart Mood Lamp
4	**Ultrasonic Sensor**	Measure distance.	Trigger; echo; distance.	Measure and display object distance.	HC-SR04	Arduino / mBlock	Distance Meter
5	**Temperature Sensor**	Read environmental conditions.	Temperature; sensor output.	Measure temperature and compare values.	Temperature sensor	Arduino	Digital Thermometer
6	**Variables**	Store and use changing data.	Variables; values; basic types.	Create a sensor counter or tracker.	Arduino-compatible board	Arduino IDE	Smart Counter
7	**Conditions**	Automate decisions.	If; else; comparison operators.	Control a fan/LED based on temperature.	Temperature sensor; fan model	Arduino IDE	Automatic Fan
8	**Loops**	Automate repeated actions.	for; while; repeated actions.	Program a traffic-light sequence.	LEDs; resistors	Arduino IDE	Automated Traffic Light
9	**Water and Environment**	Explore environmental technology.	Water level; soil moisture; conservation.	Detect soil moisture and display status.	Moisture sensor	Arduino IDE	Smart Plant Monitor
10	**IoT Introduction**	Understand connected devices.	Device; network; internet; sensor data.	Simulate or send device data.	ESP8266 / ESP32	Arduino IDE	IoT Concept Model
11	**Machine Learning Introduction**	Understand learning from examples.	Data; labels; training; prediction.	Create a small image classifier.	Computer; webcam	Teachable Machine	Image Classifier
12	**Smart Robot Challenge**	Integrate sensors, logic and motion.	System integration; testing; improvement.	Build and test an obstacle-avoiding robot.	Robotics kit	Arduino / mBlock	Smart Obstacle-Avoiding Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 6

INTERMEDIATE

CURRICULUM FOCUS

Arduino, electronics, programming, robotics mechanisms and AI foundations

CODING
Arduino IDE / introductory C++

HARDWARE
Arduino UNO, digital/analog sensors, servo, motors, buzzer

AI THREAD
AI fundamentals, data, model and introductory classification

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Engineering Design Process**	Solve structured engineering problems.	Problem definition; constraints; prototype; testing.	Complete a design challenge.	STEM kit	Design tools	Product Prototype
2	**Arduino Introduction**	Understand a microcontroller and development board.	Board; pins; IDE; upload process.	Upload first program and blink an LED.	Arduino UNO; USB cable	Arduino IDE	Blinking LED
3	**Digital Electronics**	Understand HIGH/LOW signals.	Digital input/output; logic levels.	Read switches and control LEDs.	Switch; LED; resistor	Arduino IDE	Digital Control Panel
4	**Analog Electronics**	Understand variable sensor signals.	Analog input; voltage; readings.	Read and map potentiometer/LDR values.	Potentiometer; LDR	Arduino IDE	Light Meter
5	**Sensors and Actuators**	Differentiate input and output devices.	Sensor; actuator; controller.	Combine a sensor with servo/buzzer/LED.	Sensors; servo; buzzer	Arduino IDE	Automatic Door
6	**Programming Fundamentals**	Build reliable coding logic.	Variables; operators; data types.	Solve structured coding exercises.	Computer	Arduino IDE	Sensor Calculator
7	**Conditional Programming**	Build decision-making systems.	if; else-if; comparisons.	Create multi-condition automation.	Multiple sensors	Arduino IDE	Smart Room
8	**Functions**	Create reusable code blocks.	Functions; parameters; modular programming.	Build reusable hardware-control functions.	Arduino	Arduino IDE	Multi-Function Robot
9	**Robotic Mechanisms**	Understand mechanical transmission.	Gears; linkages; wheels; mechanisms.	Build and test a mechanism.	Gears; wheels; chassis	STEM/robotics kit	Robotic Mechanism
10	**AI Fundamentals**	Explain basic AI concepts.	AI; data; model; prediction.	Test a simple AI classifier.	Computer	Teachable Machine	AI Image Classifier
11	**Data and Machine Learning**	Understand datasets and labels.	Training; testing; classification.	Create a small labeled dataset.	Computer	Teachable Machine	Object Classifier
12	**Robotics Integration**	Combine hardware and code.	System integration; calibration; troubleshooting.	Build, calibrate and test a line follower.	Arduino robotics kit	Arduino IDE	Line-Following Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 7

INTERMEDIATE

CURRICULUM FOCUS

advanced robotics, communication, IoT and machine learning

CODING
Arduino IDE / mBlock / introductory Python

HARDWARE
Arduino, ESP32, Bluetooth, motor drivers, servo, sensors

AI THREAD
machine learning workflow, datasets and AI applications

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Advanced Robotics**	Understand complete robot architecture.	Mechanical; electrical; software subsystems.	Analyze a robot architecture.	Robotics kit	Arduino IDE	Robot Architecture Model
2	**Arduino Programming**	Write structured programs.	Arrays; functions; timing.	Build a sensor automation program.	Arduino	Arduino IDE	Automated System
3	**Motor Drivers**	Control multiple motors.	H-bridge; motor driver; differential drive.	Drive two motors independently.	L298N/TB6612; DC motors	Arduino IDE	Differential Drive Robot
4	**Servo Motors**	Control precise angular movement.	Servo angle; PWM.	Program a servo mechanism.	Servo motor	Arduino IDE	Robotic Barrier
5	**Advanced Sensors**	Combine multiple sensor inputs.	IR; ultrasonic; temperature; moisture.	Create a multi-sensor monitoring system.	Sensor kit	Arduino IDE	Smart Monitoring Station
6	**Communication**	Understand device-to-device communication.	Serial; Bluetooth basics.	Send wireless commands to a robot.	Bluetooth module	Arduino IDE	Bluetooth Robot
7	**IoT Fundamentals**	Understand connected devices and dashboards.	Wi-Fi; cloud; data transfer.	Send sensor data to a dashboard.	ESP8266/ESP32	Arduino IDE	IoT Sensor
8	**Smart Home**	Build connected automation safely.	Automation; remote control; actuators.	Control low-voltage loads/model appliances.	ESP32; relay module	Arduino IDE	Smart Home Prototype
9	**Machine Learning**	Understand classification workflow.	Features; labels; training; testing.	Train a basic classifier.	Computer	Teachable Machine / Colab	ML Classifier
10	**Data Preparation**	Create useful datasets.	Collection; labeling; cleaning; balance.	Build a small dataset and inspect it.	Computer/camera	Spreadsheet / Colab	Student Dataset
11	**AI Applications**	Explore AI in real systems.	Healthcare; agriculture; education; transport.	Research and present one AI application.	Computer	Presentation tool	AI Application Model
12	**Integrated Project**	Combine robotics and IoT/AI.	Architecture; integration; evaluation.	Design and build an integrated system.	Mixed kit	Arduino + AI platform	IoT Smart Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 8

INTERMEDIATE / ADVANCED

CURRICULUM FOCUS

autonomy, computer vision, IoT, machine learning and responsible AI

CODING
Arduino IDE / Python introduction

HARDWARE
ESP32, IR/ultrasonic/ToF sensors, motors, camera, optional Raspberry Pi

AI THREAD
machine learning, computer vision and responsible AI

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Robot Architecture**	Design complete robot systems.	Controller; sensors; actuators; communication.	Create a robot system architecture.	Robotics kit	Arduino	Robot Blueprint
2	**Embedded Systems**	Understand embedded computing.	Microcontroller vs computer; embedded use cases.	Compare two embedded platforms.	Arduino; ESP32	Arduino IDE	Embedded Device
3	**Motor Control**	Control speed and direction.	PWM; H-bridge; feedback concept.	Build variable-speed motor control.	Motor driver; motors	Arduino IDE	Speed-Controlled Robot
4	**Line Following**	Build basic autonomous navigation.	IR sensing; error; correction.	Calibrate and run a line follower.	IR sensors; motors	Arduino IDE	Line Follower
5	**Obstacle Avoidance**	Make autonomous path decisions.	Distance sensing; decision rules.	Build an obstacle-avoiding robot.	Ultrasonic/ToF sensor	Arduino IDE	Autonomous Robot
6	**Wireless Robotics**	Control a robot remotely.	Bluetooth/Wi-Fi; command systems.	Build a wireless controller.	ESP32/Bluetooth	Arduino IDE	Wireless Robot
7	**IoT and Cloud**	Connect devices to dashboards.	Data transmission; cloud; visualization.	Build a sensor dashboard.	ESP32	Arduino IDE + dashboard	IoT Weather Station
8	**AI Concepts**	Understand AI model training.	Dataset; features; labels; inference.	Train a simple classifier.	Computer	Teachable Machine	AI Classifier
9	**Machine Learning**	Understand model evaluation.	Training/testing; accuracy; classification.	Compare simple models.	Computer	Google Colab	ML Prediction Model
10	**Computer Vision**	Understand machine perception.	Image; pixel; classification; detection.	Recognize a selected object with a camera.	Webcam	OpenCV / Teachable Machine	Vision Detector
11	**AI Ethics**	Understand responsible AI.	Bias; fairness; privacy; misinformation.	Analyze an AI case study.	Computer	Presentation tool	Responsible AI Report
12	**Capstone Robotics**	Integrate robotics and AI.	System design; testing; documentation.	Build and evaluate a complete project.	Mixed	Arduino/Python	AI-Assisted Autonomous Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 9

ADVANCED

CURRICULUM FOCUS

Python, data, machine learning, computer vision, IoT and autonomous robotics

CODING
Python / Arduino / ESP32

HARDWARE
Arduino/ESP32, sensors, motors, Raspberry Pi or PC camera

AI THREAD
machine learning and computer vision

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Engineering and Automation**	Understand automated systems and feedback.	Automation; control; feedback.	Analyze an automated system.	Models/components	No-code / Python	Automation Diagram
2	**Python Basics**	Learn programming fundamentals.	Variables; data types; operators.	Write and run Python programs.	Computer	Python / Thonny	Calculator
3	**Python Decision Making**	Implement logic in Python.	if; elif; else.	Build decision-based programs.	Computer	Python	Smart Decision Program
4	**Python Loops and Functions**	Create reusable programs.	Loops; functions.	Solve patterns and automation exercises.	Computer	Python	Pattern Generator
5	**Data Structures**	Store and organize information.	Lists; tuples; dictionaries.	Process structured data.	Computer	Python	Student Data Analyzer
6	**Robotics Electronics**	Connect code to physical systems.	GPIO; sensors; actuators; interfaces.	Control sensors or outputs.	Arduino/ESP32	Python + board tools	Sensor Controller
7	**Autonomous Navigation**	Build navigation logic.	Obstacle avoidance; path planning concept.	Test rover navigation.	Motors; distance sensors	Python/Arduino	Autonomous Rover
8	**IoT**	Build connected monitoring.	Web communication; MQTT concept; dashboards.	Send and visualize sensor data.	ESP32	Arduino/Python	IoT Monitor
9	**AI Fundamentals**	Understand intelligent systems.	Agents; prediction; classification.	Build an introductory AI workflow.	Computer	Python / Colab	AI Decision System
10	**Machine Learning**	Train and evaluate an ML model.	Features; labels; train/test.	Train a classifier.	Computer	Google Colab / Python	ML Classifier
11	**Computer Vision**	Process images and video.	Pixels; preprocessing; image classification.	Process webcam or image data.	Webcam	OpenCV / Python	Object Recognition
12	**AI-Robotics Project**	Integrate AI and robotics.	Architecture; testing; evaluation.	Build a complete AI-enabled robot.	Robotics + computer	Python + Arduino	AI Vision Robot

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 10

ADVANCED

CURRICULUM FOCUS

AI, ML, data visualization, computer vision, NLP, IoT and robotics

CODING
Python / Arduino / ESP32

HARDWARE
ESP32/Raspberry Pi, sensors, motors, camera

AI THREAD
AI, machine learning, computer vision and NLP foundations

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Advanced Python**	Write structured and robust Python applications.	Modules; exceptions; files.	Build a small utility application.	Computer	Python	Utility Application
2	**Algorithms**	Develop systematic solutions.	Algorithms; flowcharts; complexity basics.	Solve logic and search problems.	Computer	Python	Algorithm Challenge
3	**Data Structures**	Manage larger datasets.	Lists; dictionaries; sets.	Analyze structured information.	Computer	Python	Data Analysis Tool
4	**Embedded Robotics**	Understand robot control architecture.	Microcontrollers; feedback.	Control a small robot platform.	ESP32/Arduino	Arduino IDE / Python	Embedded Robot
5	**IoT Communication**	Transfer sensor data reliably.	Wi-Fi; HTTP; MQTT concepts.	Build a connected sensor.	ESP32	Arduino + dashboard	IoT Monitoring System
6	**Artificial Intelligence**	Explain and prototype AI systems.	AI categories; agents; inference.	Build a small AI application.	Computer	Python	AI Assistant Prototype
7	**Machine Learning**	Build and evaluate ML models.	Regression; classification; clustering.	Train and compare models.	Computer	Python / Colab	Prediction Model
8	**Data Visualization**	Interpret and communicate data.	Charts; distributions; trends.	Create a data dashboard.	Computer	Python / Matplotlib	Data Dashboard
9	**Computer Vision**	Understand machine vision pipelines.	Image processing; classification; detection.	Build an image recognition system.	Webcam	OpenCV / Python	Vision System
10	**NLP Introduction**	Understand language AI.	Text; tokens; classification.	Create a simple text classifier.	Computer	Python / Colab	Text Classification
11	**Responsible AI**	Evaluate AI risks and limitations.	Bias; fairness; privacy; misinformation.	Analyze real-world cases.	Computer	Presentation tool	AI Ethics Case Study
12	**Capstone**	Build an intelligent end-to-end system.	Requirements; development; testing.	Complete full project lifecycle.	Robotics + AI	Python + hardware	AI & Robotics Smart System

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project

CLASS 11

ADVANCED / SENIOR SECONDARY

CURRICULUM FOCUS

AI engineering, mathematics, embedded systems, kinematics, control, ML and edge AI

CODING
Python / Jupyter / Google Colab / Arduino

HARDWARE
ESP32/Arduino, robotic arm, sensors, Raspberry Pi or similar edge device

AI THREAD
machine learning, neural networks, computer vision and edge AI

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Foundations of AI**	Develop deeper AI understanding.	Intelligent agents; search; reasoning.	Solve small AI problems.	Computer	Python	AI Problem Solver
2	**Python for AI**	Use Python for AI workflows.	NumPy; Pandas basics.	Load, inspect and analyze a dataset.	Computer	Python / Jupyter / Colab	Dataset Analyzer
3	**Data Structures for AI**	Choose suitable data structures.	Arrays; dictionaries; stacks; queues.	Implement and compare structures.	Computer	Python	Data Processing Program
4	**Mathematics for AI**	Understand mathematical foundations.	Statistics; probability; vectors; matrices.	Calculate and visualize basic metrics.	Computer/calculator	Python	Statistical Analyzer
5	**Electronics and Embedded Systems**	Design embedded solutions.	Microcontrollers; power; interfaces.	Build an embedded monitoring device.	ESP32/Arduino	Arduino IDE	Embedded Monitoring System
6	**Robotics Kinematics**	Model robotic movement.	Joints; links; degrees of freedom; position.	Simulate arm movement.	Robotic arm kit	Python / CAD	Robotic Arm Model
7	**Control Systems**	Understand feedback control.	Open/closed loop; PID concept.	Tune a simple motor or line-control system.	Motors; sensors	Arduino/Python	Line Control System
8	**Machine Learning**	Build and evaluate models.	Regression; classification; clustering.	Train multiple models and compare results.	Computer	Python / Scikit-learn	ML Comparison Study
9	**Neural Networks**	Understand neural computation.	Neurons; layers; weights; activation.	Train a small neural network.	Computer	Python / Colab	Neural Network
10	**Computer Vision**	Build visual intelligence.	Feature extraction; recognition; detection.	Create a real-time vision application.	Webcam	OpenCV / Python	Vision Application
11	**Edge AI and IoT**	Understand local AI processing.	Edge computing; latency; cloud vs edge.	Run a small model near the device.	Raspberry Pi / similar	Python	Edge AI Prototype

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
12	**Research Project**	Practice engineering research.	Problem statement; methodology; testing; documentation.	Build and evaluate a research-oriented project.	Mixed	Python + robotics	Research-Based AI Robot

CLASS 12

ADVANCED / PRE-PROFESSIONAL

CURRICULUM FOCUS

deep learning, data science, autonomous robotics, NLP, edge AI and capstone engineering

CODING
Professional Python / Colab / OpenCV / ML frameworks / robotics tools

HARDWARE
Raspberry Pi or Jetson-class device, ESP32, camera, mobile robot, optional robotic arm

AI THREAD
ML, neural networks, deep learning, computer vision, NLP and edge AI

12-Chapter Scope

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
1	**Advanced AI**	Understand complete AI pipelines.	Perception; reasoning; action; intelligent agents.	Design an intelligent agent workflow.	Computer	Python / Colab	Intelligent Agent
2	**AI Programming**	Write modular AI applications.	Python; NumPy; Pandas; reusable modules.	Develop an AI data application.	Computer	Python	AI Data Application
3	**Data Science**	Analyze real datasets.	Cleaning; exploration; statistics.	Prepare and analyze a dataset.	Computer	Pandas / Colab	Data Science Report
4	**Supervised and Unsupervised ML**	Compare machine learning approaches.	Regression; classification; clustering.	Train and compare models.	Computer	Scikit-learn	ML Model Comparison
5	**Neural Networks and Deep Learning**	Understand deep learning pipelines.	Layers; activation; loss; backpropagation concept.	Train a basic neural network.	Computer/GPU optional	TensorFlow / PyTorch / Colab	Neural Network Model
6	**Computer Vision**	Build visual AI systems.	Image pipelines; CNN concept; object detection.	Recognize images or objects.	Webcam	OpenCV + ML framework	AI Vision System
7	**Natural Language Processing**	Build language-based AI.	Tokenization; text classification; embeddings concept.	Create a text application.	Computer	Python / Colab	NLP Assistant
8	**Robotics Kinematics**	Model robotic motion mathematically.	Forward/inverse kinematics; coordinates.	Simulate a robotic arm.	Robotic arm	Python / CAD	Robotic Arm Simulation
9	**Autonomous Navigation**	Build autonomous decision systems.	Localization; mapping concepts; path planning.	Navigate a robot through an arena.	Mobile robot; sensors	Python / robotics platform	Autonomous Rover

Ch.	Chapter	Learning Objectives	Theory Topics	Practical Activity	Components	Platform	Project
10	**Edge AI and Smart Systems**	Deploy AI near devices.	Edge computing; latency; IoT integration.	Run an AI model on an edge device.	Raspberry Pi / Jetson / ESP32 as appropriate	Python	Edge AI Device
11	**AI Ethics, Security and Future**	Evaluate advanced technology responsibly.	Privacy; cybersecurity; bias; safety; societal impact.	Conduct a risk and ethics case study.	Computer	Presentation / report	Responsible AI Framework
12	**Grand Capstone Project**	Solve a real-world problem end-to-end.	Research; design; implementation; testing; documentation; presentation.	Complete and defend a major project.	Student-selected	Python + Robotics + AI	Major AI & Robotics Capstone

Program Outcome by Class 12

By the end of Class 12, a student should have progressed from observing and building simple STEM systems to designing, coding, evaluating and presenting AI-enabled robotic solutions.

Stage	Classes	Student Capability
STEM Explorer	**Classes 3-4**	Observe, build, ask questions and understand simple machines, circuits and robots.
Maker & Coder	**Classes 5-6**	Use sensors, motors and microcontrollers; write structured beginner programs.
Robotics & IoT Builder	**Classes 7-8**	Build connected and increasingly autonomous systems; understand ML and computer vision basics.
AI & Robotics Developer	**Classes 9-10**	Use Python, data, ML, computer vision and IoT to develop intelligent systems.
AI/Robotics Engineer	**Classes 11-12**	Apply mathematics, control, kinematics, deep learning, edge AI and research methods to major projects.

Implementation Note

Component selection can be adapted to the school laboratory budget and existing infrastructure. Equivalent boards, sensors and software platforms may be substituted without changing the learning outcomes. For electrical safety, student projects should use low-voltage educational circuits and teacher-approved power supplies.